Tests of stainless steel circular tubular stub columns with seawater sea-sand concrete infill

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Abstract

A series of cold-formed austenitic stainless steel (CFASS) circular tubular stub columns infilled with seawater sea-sand concrete (SWSSC) were designed, fabricated and tested. The CFASS circular tubes had 3 different cross-sections with its nominal outer diameter of 60.5, 114.3 and 165.2 mm. The concrete mixes were of strength levels 35 and 70 MPa. Axial compression tests were carried out to study their structural behaviour in terms of load-strain curve, strength, ductility and failure mode. The test results revealed that the use of SWSSC in place of conventional concrete in CFASS tubes has little effect on the structural behaviour. The test results were also compared with predictions by existing design equations in the codes. It was found that the existing design equations are either un-conservative or overly conservative. A new and more accurate design equation for axially loaded concrete-filled stainless steel circular tubular stub columns was proposed.

Keywords: Concrete-filled steel tubes; seawater sea-sand concrete; stainless steel structures.

1 Introduction

Concrete-filled steel tubes (CFSTs) have become quite widely used in various structural members. Recently, their possible applications in submarine pipeline structures have been explored [1]. There are also investigations on high performance CFST columns made of high-strength steel tubes with proof stress higher than 1000 MPa [2], and those made of high-strength concrete with cylinder strength up to 190 MPa [3]. Due to the acute shortage of fresh water and river sand in many places, especially remote coastal areas [4] such as outlying islands, and the large carbon footprint of cement manufacturing, which has been causing global warming, it has been advocated in recent years to reduce fresh water, river sand and cement consumptions. To solve these problems, various attempts from the materials standpoint have been made, such as using seawater and sea-sand to replace fresh water and river sand, e.g. [5], adding alkali activated binders to completely replace cement, e.g. [6], and adding limestone fines, e.g. [7], to partially replace cement. Attempts from the structural standpoint of employing more efficient structural forms, such as CFSTs, to make better use of concrete and reduce cement consumption have also been made, as in the present study.

The uses of seawater and sea-sand to replace fresh water and river sand have led to the development

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